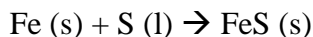


## LIMITING REAGENT Practice Problems #2

1. At high temperatures, sulfur combines with iron to form the brown-black iron (II) sulfide:



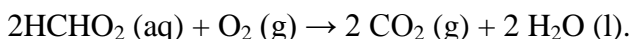
In one experiment, 7.62 g of Fe are allowed to react with 8.67 g of S.

- What is the limiting reagent, and what is the reactant in excess?
  - Calculate the mass of FeS formed.
2. Acrylonitrile,  $\text{C}_3\text{H}_3\text{N}$ , is the starting material for the production of a kind of synthetic fiber (acrylics) and can be made from propylene,  $\text{C}_3\text{H}_6$ , by reaction with nitric oxide, NO, as follows:



What mass of  $\text{C}_3\text{H}_3\text{N}$  can be made when 21.6 g of  $\text{C}_3\text{H}_6$  react with 21.6 g of nitric oxide?

3. Calculate the percent yield for the reaction:  $\text{P}_4 \text{ (s)} + 6 \text{Cl}_2 \text{ (g)} \rightarrow 4 \text{PCl}_3 \text{ (l)}$  if 75.0 g of phosphorus reacts with excess chlorine gas to produce 111.0 g of phosphorus trichloride.
4. Formic acid,  $\text{HCHO}_2$ , burns in oxygen to form carbon dioxide and water as follows:



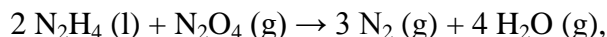
If a 3.15-g sample of formic acid was burned in 2.0 L of oxygen, what volume of carbon dioxide would be produced? (Assume the reaction occurs at standard temperature and pressure, STP.)

5. Zinc metal reacts with hydrochloric acid to produce zinc chloride and hydrogen gas.
- Balance the following reaction:  $\text{Zn (s)} + \text{HCl (aq)} \rightarrow \text{ZnCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)}$
  - A 3.50-g sample of zinc metal is allowed to react with 2.50 g of hydrochloric acid.

Complete the following table:

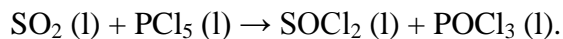
Reactants/products	Zn (grams)	HCl (grams)	ZnCl <sub>2</sub> (grams)	H <sub>2</sub> (L)
Before reaction				
After reaction	1.26 g			

6. Consider the reaction:  $\text{MnO}_2 + 4 \text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + 2 \text{H}_2\text{O}$   
If 0.45 mols of  $\text{MnO}_2$  can react with 48.2 g of HCl, how many grams of  $\text{Cl}_2$  could be produced?
7. One of the components of the fuel mixture on the Apollo lunar module involved a reaction with hydrazine,  $\text{N}_2\text{H}_4$ , and dinitrogen tetroxide,  $\text{N}_2\text{O}_4$ . If the balanced equation for this reaction is



What volume of  $\text{N}_2$  gas (measured at STP, 22.4L/mol) would result from the reaction of 1500 kg of hydrazine and 1000 kg of  $\text{N}_2\text{O}_4$ ?

8. Calculate the percent yield for an experiment in which 5.50 g of  $\text{SOCl}_2$  was obtained in a reaction of 5.80 g of  $\text{SO}_2$  with excess  $\text{PCl}_5$ . Use the following equation:



9. Chlorine gas reacts with silica,  $\text{SiO}_2$ , and carbon to give silicon tetrachloride and carbon monoxide.
- Balance the following equation:  $\text{Cl}_2 (\text{g}) + \text{SiO}_2 (\text{s}) + \text{C} (\text{s}) \rightarrow \text{SiCl}_4 (\text{l}) + \text{CO} (\text{g})$
  - How much  $\text{CO}$  gas can be produced from 15.0 g of silica?
10. When iron (II) hydroxide is mixed with phosphoric acid, iron (II) phosphate solid (precipitate) forms.
- Balance the following equation:  $\text{Fe}(\text{OH})_2 (\text{aq}) + \text{H}_3\text{PO}_4 (\text{aq}) \rightarrow \text{Fe}_3(\text{PO}_4)_2 (\text{s}) + \text{H}_2\text{O} (\text{l})$
  - If 3.20 g of  $\text{Fe}(\text{OH})_2$  is treated with 2.50 g of phosphoric acid, what is the limiting reagent and what is the reactant in excess?
  - How many grams of  $\text{Fe}_3(\text{PO}_4)_2$  precipitate can be formed?
  - If 3.99 g of  $\text{Fe}_3(\text{PO}_4)_2$  is actually obtained, what is the percent yield?

### Answer Key

- Fe is the limiting reagent, S is in excess
  - 11.97 g  $\text{FeS}$  formed
- 2.25.5 g  $\text{C}_3\text{H}_3\text{N}$
- % yield = 33.3%
- 1.53 L  $\text{CO}_2$
- $\text{Zn} (\text{s}) + 2 \text{HCl} (\text{aq}) \rightarrow \text{ZnCl}_2 (\text{aq}) + \text{H}_2 (\text{g})$
  - Shown below:
- 23.4 g  $\text{Cl}_2$
- $7.30 \times 10^5 \text{ L N}_2 \text{ gas}$
- 51.0%
- $2 \text{Cl}_2 (\text{g}) + \text{SiO}_2 (\text{s}) + 2 \text{C} (\text{s}) \rightarrow \text{SiCl}_4 (\text{l}) + 2 \text{CO} (\text{g})$
  - 14.0 g  $\text{CO}$  gas

Reactants/products	Zn (grams)	HCl (grams)	$\text{ZnCl}_2$ (grams)	$\text{H}_2$ (L)
Before reaction	<b>3.50</b>	<b>2.50</b>	<b>0</b>	<b>0</b>
After reaction	1.26 g	<b>0</b>	<b>4.67</b>	<b>0.768</b>

10. a.  $3 \text{Fe}(\text{OH})_2 (\text{aq}) + 2 \text{H}_3\text{PO}_4 (\text{aq}) \rightarrow \text{Fe}_3(\text{PO}_4)_2 (\text{s}) + 6 \text{H}_2\text{O} (\text{l})$
- $\text{Fe}(\text{OH})_2$ =limiting reagent,  $\text{H}_3\text{PO}_4$  in excess
  - 4.24 g  $\text{Fe}_3(\text{PO}_4)_2 (\text{s})$
  - 94.0%